Standoff Ultra-Compact Raman system Development for faster daytime mineralogy and Raman Imaging (SUCR)

Completed Technology Project (2016 - 2019)

Project Introduction

Raman spectroscopy can positively identify organic molecules, biomarkers, biominerals, water, water containing minerals, and minerals that are of high interest to NASA and directly serve the goal of finding evidence for past life on Mars and other planets. Micro-Raman systems are capable of performing fine-scale mineralogy; hence, they are being actively proposed as instruments on planetary rovers for in situ analysis. Most of the micro-Raman systems for planetary exploration are implementation of traditional Raman technology that is designed for dark laboratory use. These Raman systems have the following characteristics (1) they require sample collection, (2) they will require shielding of daylight background radiation. In addition, presence of mineral and biological luminescence significantly affect the Raman signal. Due to the use of continuous wave (CW) lasers and non-time gating detection approach, it will also be difficult to distinguish the biofluorescence from the mineral phosphorescence. These limitations will significantly lower the science return from these micro-Raman systems in terms of number and variety of samples that can be analyzed on Mars. Under this proposal, we propose to develop an innovative "Standoff Ultra-Compact Raman" (SUCR) instrument in collaboration with the University of Hawaii, which will use the superior pulsed time gated Raman technology capable of operating in daylight while minimizing contribution from mineral phosphorescence. SUCR will provide a superior micro-Raman instrument for future NASA missions. The development of SUCR will require improvements in both remote Raman and ultra-compact Raman technologies and the implementation of line imaging for faster Raman context imaging and map collection. The SUCR system will be able to quickly collect (1 s/spectrum) high quality in situ Raman spectral images in the daytime, from distances of several centimeters, with no need for samples collection. For example, the SUCR instrument will allow for fine scale context mineralogy of drilled cores, layer structures, and trenches. In addition, SUCR will be able to detect any micron size biomarker in situ with its faster search and scan mode (0.1s). Furthermore, we will demonstrate that SUCR can be used to detect the past life forms, to utilize fluorescence to distinguish biological from non-biological sources, and to show the system improvement with respect to existing systems. Under this project, the TRL of the proposed SUCR instrument will advance from TRL 2 to TRL 4.

Standoff Ultra-Compact Raman system Development for faster daytime mineralogy and Raman Imaging

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

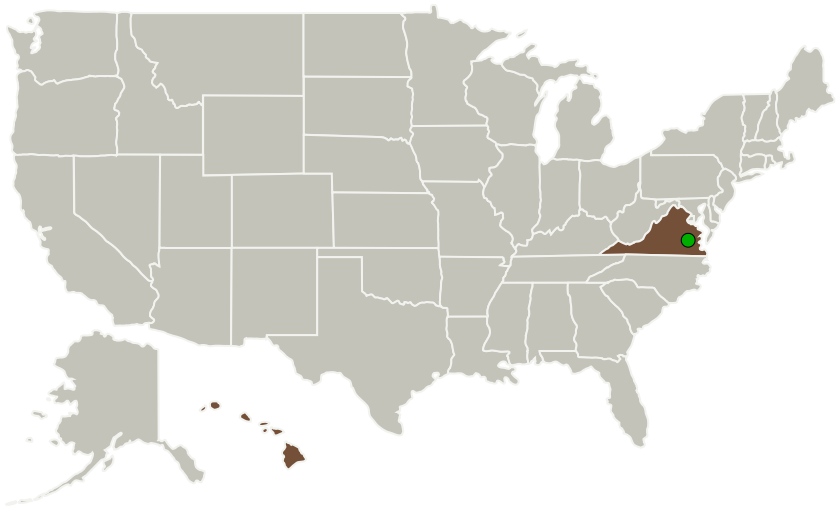
Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

Standoff Ultra-Compact Raman system Development for faster daytime mineralogy and Raman Imaging (SUCR)

Completed Technology Project (2016 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Hawaii	Virginia

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

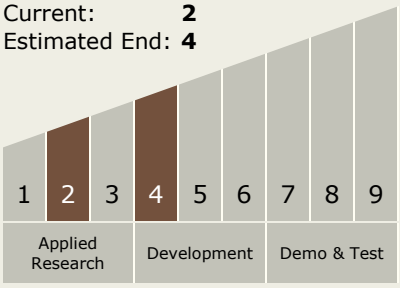
M N Abedin

Co-Investigators:

Anupam K Misra
Rebecca W Bales
Arthur T Bradley
Shiv K Sharma

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Standoff Ultra-Compact Raman system Development for faster daytime mineralogy and Raman Imaging (SUCR)

Completed Technology Project (2016 - 2019)

Target Destination

Others Inside the Solar System